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(54) Wet-formed mat applications for cement backerboards

(57) A wet-formed permeable mat (10) composed of wet use chopped strands (WUCS) (18), chopped roving (22), and potentially unidirectional roving coupled with an alkaline resistant binder (16) are combined to create a randomly oriented open mat structure with a high degree of openness that can be used in cement backerboard applications. The cement backerboard (110) that

is subsequently formed from the wet-formed permeable mat has lower binder content, superior decorative finish and better permeability control than known glass scrim systems and can be produced in a single continuous operation.

EP 1 346 964 A2

Description

[0001] The present invention relates generally to cement backerboards and more specifically to wet formed mat applications for cement backerboards.

[0002] Interior and exterior construction boards with cores of plaster, cement, or hybrid materials, such as cement boards or gypsum boards, are used in a wide variety of indoor and outdoor structural applications. For example, cement boards are used as a support surface for overlying materials such as wood siding, stucco, aluminum, brick, tile, stone aggregate and marble. Also, cement boards are used in exterior insulating systems, commercial roof deck systems, masonry applications and exterior curtain walls.

[0003] Generally, cement boards contain a core formed of a cementitious material and low density fillers that are interposed between two facing layers. Facing materials advantageously contribute flexural and impact strength to the high compressive strength but brittle material forming the cementitious core. In addition, the facing material can provide a durable surface and/or other desirable properties to the cement board.

[0004] One material that has been used to form facing materials is alkaline resistant, binder coated glass fibers. Glass fiber facings provide increased dimensional stability in the presence of moisture and provide greater physical and mechanical properties to the cement board. These facing sheets are formed as randomly oriented fibrous glass mats or open mesh glass scrims formed from continuous glass yarns. Known methods for making cementitious boards consists of providing a continuous feed of facing material and depositing a cementitious slurry onto the top surface of the facing material. A second continuous feed of facing material is then applied to the top surface of the slurry. The slurry is dried to harden the cementitious composition and to integrate the facing material into the cement board. The cement board is subsequently cut to a predetermined length for shipping and eventual use.

[0005] Known glass scrim systems used to make the glass facing sheets typically include about 60% polyvinyl chloride (PVC) and glass scrim solutions that are manufactured in an expensive, two step process. Although some binder protection from highly alkaline conditions is required, the high binder levels are more likely due to process/coating related issues. Higher binder loading levels are required in existing glass facing sheets due to (i) throughput issues in a single strand coating operation, if precoated strands are employed; (ii) coating control issues that arise in coating pre-wetted fabrics; and (iii) possible wet out issues associated with thick, plasticized PVC resins. Biaxial 0/90 oriented scrims exhibit pitting in highly open porous regions.

[0006] It is therefore highly desirable to provide glass scrim system that can be formed in a single step operation that uses less binder material. It is also highly desirable that such a process will result in superior decorative finishes and better permeability control.

[0007] The present invention comprises combining an alkaline resistant binder with a permeable wet-formed mat composed of wet use chopped strands (WUCS), chopped dry strands or roving, and potentially unidirectional roving to create an open mat structure that can be used in cement backerboard applications.

[0008] A unique aspect of the present invention is the behavior of the wet chop strands and dry chop strands in the dispersion prior to forming the mat. Wet chop strands tend to spread out randomly within the whitewater dispersion. Dry chop strands will also randomly orient, however the material tends to stay together in the whitewater dispersion (like a log). Hence, the permeable matting formed is not a completely random network of wet and dry chop, thereby giving a mat with a higher degree of openness as measured by Frazier air permeability. This improves cement impregnation.

[0009] The invention is described below in greater detail by way of example only with reference to the accompanying drawings, in which

Fig. 1 is a perspective view of a randomly oriented open mesh filament network according to a preferred embodiment of the present invention;

Fig. 2 is a perspective view of a randomly oriented open mesh filament network according to another preferred embodiment of the present invention;

Fig. 3 is a perspective view of a processing line used to form the a wet formed permeable mat and the randomly oriented open mesh filament network of Figs. 1 and 2; and

Figs. 4-9 illustrate the manner of precasting the cement backerboard using the wet permeable mat of Fig. 3.

[0010] Figs. 1 and 2 illustrate a randomly oriented open mesh filament network 14 according to two preferred embodiments of the present invention. As will be shown in Fig. 3 below, the randomly oriented open mesh filament network 14 of Figs. 1 and 2 may then be impregnated with an alkaline resistant binder 16 to form a wet permeable mat 10. This wet permeable mat 10, in turn, may be immersed and embedded with cement to form a cement backerboard 110 having improved decorative characteristics and other properties as described in Fig. 4.

[0011] Referring to Fig. 1, the randomly oriented open mesh filament network 14 comprises a combination of sized wet use chop strands (WUCS) 18 and sized dry chop fiber strands 20 in lengths between approximately 0.75 and 1.5

inches (1.91 and 3.81 centimeters) in approximately a 25-75/75-25 weight percentage ratio (or between a 3:1 and 1:3 weight percent ratio). As shown in Fig. 3 below, the strands 18, 20 are randomly dispersed throughout the network 14 using a whitewater chemical dispersion 71.

[0012] Preferably, the strands 18, 20 comprise E-type glass filaments, S-type glass filaments, alkaline resistant glass filaments, or ECR-type glass filaments such as Owens Corning's Advantex® glass fibers. However, other types of fiber having sufficient modulus (i.e. similar in modulus to the fibers described above) may be used as well, including basalt fibers and wood natural fibers such as cellulose and wood.

[0013] In the case of wet use chop strands 18, low solids sizing compositions are employed that contain high dispersive chemistries. The finished product remains in a moist state having moisture contents running between 10 and 25%. One preferred wet use chop strand 18 having a low solids sizing that meets these requirements is Owens Corning's 9501 filaments.

[0014] In the case of dry chop strands 20, sizing compositions having higher solids levels are employed, and the filaments are dried and cured before final packaging. One preferred dry chop strand 20 having a high solids coating that meets these requirements is Owens Corning's 893 filaments, available in roving form but capable of being chopped into the proper size by methods well known in the art.

[0015] In an alternative preferred embodiment, as shown in Fig. 2, the network 14 also comprises unidirectional rovings 22 combined with a 25-75/75-25 weight percentage ratio of wet use and dry strands 18, 20. The unidirectional rovings 22 comprise approximately 20 to 50% of the total fiber weight of the network 14. The unidirectional rovings 22 have a similar sizing composition to the dry use strands 20. One preferred unidirectional roving 22 that meets these requirements is Owens Corning's 377 unidirectional glass rovings.

[0016] Fig. 3 illustrates a processing line 17 used for forming the random open mesh filament network 14 of Figs. 1 and 2 and further forming a wet process permeable mat 10 that is used to make a cement backerboard 110. A 25-75/75-25 by weight percentage combination of the wet chop 18 and dry chop strands 20 are added to a whitewater chemical dispersion 71 within a whitewater tank 70 to form a thick whitewater slurry 72 at consistency levels of approximately 0.2 to 1 percent. The whitewater chemical dispersion 71 is used to obtain reasonable filamentation of wet use strands 18 through steric, thermodynamic, and charge colloidal interactions. A preferred whitewater dispersion 71 includes a cationic dispersant, an anionic viscosity modifier, a defoamer and a blockade. The pH of the whitewater chemical dispersion 71 is maintained at approximately 8 by adding ammonia. To take advantage of charge differences between mostly anionic and partially cationic surfaces of the E-type glass, the cationic dispersant is typically added first, followed by the strands 18, 20, defoamer, and viscosity modifier to form the dispersion 71. Additives such as dry strength agents and wet strength agents known in the art may also be added to the dispersion 71.

[0017] The anionic viscosity modifiers used in the whitewater dispersion 71 preferably have molar anionicities between approximately 25 and 40% and molecular weights of about 16 million. One preferred class of anionic viscosity modifiers is a polyacrylamide viscosity modifier such as Nalco 7768, Magnifloc 1886A, and HyChem AE 874. However, other possible viscosity modifiers or flocculants that may be used include hydroxyethyl cellulose and polyamines.

[0018] Preferably, the cationic dispersants used comprise ethoxylated alkylamine dispersants such as Nalco 8493, Schercoop DS-140, and Rhodameen VP532. However, other dispersants may be used as well, including amine oxides and polyethoxylated derivatives of amide condensation of fatty acid products. Also, preferred defoamers include Nalco PP04-3640 and Nopco NXZ.

[0019] A unique aspect of the present invention is the behavior of the wet chop strands 18 and dry chop strands 20 in the dispersion 71. The wet chop strands 18 have a tendency to spread out randomly within the dispersion 71. The dry chop strands 20 will also randomly orient, however the material tends to stay together in the dispersion 71 (like a log). Hence, the network 14 and subsequently formed permeable mat 10 formed is not a completely random network of wet and dry chop strands 18, 20. As will be discussed below, the permeable mat 10 that is formed has a higher degree of openness as measured by Frazier air permeability. This improves cement impregnation.

[0020] The thick slurry 72 formed is maintained under agitation in a single tank 73 or series of tanks. The thick slurry 72 is then delivered through a control valve 74 and combined with a thin stock stream 76 from a silo 78 to form a lower consistency slurry 80 in the former 82. The thin stock stream 76 comprises the same whitewater chemicals as the thick slurry 72 with low concentrations of the strands 18, 20. The ratio of thick slurry 72 to the silo stream 78 in the lower consistency slurry 80 should not exceed 20:1 to obtain good mixing characteristics.

[0021] The former 82 functions to equally distribute and randomly align the strands 18, 20 to form the open mesh filament network 14. Formers 82 that can accommodate the initial fiber formation include Fourdrinier machines, Stevens Former, Roto Former, Inver Former, cylinder, and VertiFormer machines. These formers offer several control mechanisms 90 to control fiber orientation within the network 14 such as drop leg and various pond regulator/wall adjustments.

[0022] Deposited fibers forming the network 14 are partially dried over a suction box 94 to exhibit correct release characteristics from the former wire 96 to the saturator section 98. Preferably, the network 14 is guided from the former 82 to the saturator section 98 through a contact vacuum roller.

[0023] Upon entering the saturator section 98, the network 14 is further dried with a first suction box 100. A blinder

is then poured onto the network 14 from a curtain coater 16 or similar depositing device. The binder 16 coats and is pulled through the network 14 using a second suction box 104. Additional suction boxes 106 may be employed to control the binder basis weight. Ideally, binder basis weight level is measured at the end of the line 17 using a binder basis-measuring device 108. The network 14 is subsequently dried and cured in a dryer 110 such as a through-air dryer or honeycomb dryer to form the wet formed permeable mat 10.

[0024] If optional unidirectional rovings 22 are used, they are introduced to the network 14 from a creel stand 101, wherein operators will string the rovings 22 through guide dyes onto the network 14 that move slightly back and forth in the CD direction. Rovings are saturated with binder and are introduced prior to the binder curtain coater but after the first saturator suction box.

[0025] The binder 16 must provide alkalinity resistant for the fibers to work since silica, which is used in the glass network 14, is attacked under strong alkaline conditions. Glass transition temperature is also an important criteria in selecting an appropriate binder 16. For example, binders 16 having a glass transition temperature near the boiling point of water experience moisture diffusion/resin velocity problems that adversely affect film formation and mechanical properties.

[0026] Alkaline resistant binders 16 that meet these criteria and may be used include phenolics, melamines, acrylics, styrene-acrylates, styrene butadiene, and ethylene vinyl acetate. Preferably, phenolic-based binders are used, such as Borden Chemical's 9901 phenolic binder. Another preferred non-phenolic based binder that is used is Rohm and Haas' GL618 acrylic copolymer, which has a glass transition temperature of approximately 35°C (95°F). Example formulations for the mats 10 without unidirectional rovings 22 made with the 20% by weight acrylic binder and 30% by weight phenolic binder at various mat weights is illustrated below in Tables 1-6, while example formulations for mats 10 made with unidirectional rovings 22 are shown in Tables 7 and 8:

TABLE 1

GL 618 Example Handsheet Formulations			
Overall Compositions in a 2 lb/sq mat with 20% Binder			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	3.3
893 Chopped SMC	893 sized Dry Chop	Owens Corning	3.3
GL 618	Acrylic Binder	Rohm & Haas	1.7
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

* Dry glass portion of WUCS

TABLE 2

Overall Compositions in a 2.5 lb/sq mat with 20% Binder			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	4.2
893 Chopped SMC	893 sized Dry Chop	Owens Corning	4.2
GL 618	Acrylic Binder	Rohm & Haas	2.1
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

* Dry glass portion of WUCS

TABLE 3

Overall Compositions in a 3.0 lb/sq mat with 20% Binder			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	5.0
893 Chopped SMC	893 sized Dry Chop	Owens Corning	5.0
GL 618	Acrylic Binder	Rohm & Haas	2.5
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

* Dry glass portion of WUCS

TABLE 4

RE 176 Phenolic Example Handsheet Formulations			
Overall Compositions in a 2 lb/sq mat with 30% Binder			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	2.9
893 Chopped SMC	893 sized Dry Chop	Owens Corning	2.9
AL-5901A	Phenolic Binder	Borden	2.5
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

* Dry glass portion of WUCS

TABLE 5

Overall Compositions in a 2.5 lb/sq mat with 30% Binder			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	3.6
893 Chopped SMC	893 sized Dry Chop	Owens Corning	3.6
AL-5901A	Phenolic Binder	Borden	3.1
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

* Dry glass portion of WUCS

TABLE 6

Overall Compositions in a 3.0 lb/sq mat with 30% Binder			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	4.4

* Dry glass portion of WUCS

EP 1 346 964 A2

TABLE 6 (continued)

Overall Compositions in a 3.0 lb/sq mat with 30% Binder			
Name	Description	Company	Amount
893 Chopped SMC	893 sized Dry Chop	Owens Corning	4.4
AL-5901A	Phenolic Binder	Borden	3.7
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

TABLE 7

Unidirectional Roving Example Handsheets			
Amount of Glass / Whitewater Required for 2.5 lb/sq product at 20% LOI			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	2.1
893 Chopped SMC	893 sized Dry Chop	Owens Corning	2.1
377 Roving	377 Roving	Owens Corning	4.2
GL 618	Acrylic Binder	Rohm & Haas	2.1
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

*Dry glass portion of WUCS

TABLE 8

Amount of Glass / Whitewater Required for 2.5 lb/sq product at 30% LOI			
Name	Description	Company	Amount
9501 WUCS*	9501 sized Wet Chop	Owens Corning	1.8
893 Chopped SMC	893 sized Dry Chop	Owens Corning	1.8
377 Roving	377 Roving	Owens Corning	3.6
AL-5901A	Phenolic Binder	Borden	3.1
Nalclear 7768	Anionic Viscosity Modifier	Nalco	Trace
8493	Cationic Dispersant	Nalco	Trace
PP04-3840	Defoamer	Nalco	Trace
			(Gram)

*Dry glass portion of WUCS

[0027] Tables 9A and 9B compares mats 10 made according to the present invention using various binder compositions with known mat systems and mat systems having variations of the preferred mat 10 compositions and to illustrate physical and decorative properties.

TABLE 9A

Binder Material	Description	Binder Manufacturer	Basis Weight (lb/sq)	Basis Weight (gm)	LOI (%)	Glass Basis Weight (lb/sq)	Binder Basis Weight (lb/sq)	Thickness (0.001")
PVC	PVC Scrim - 0990 PVC/E- Glass Tows (60% LOI)		2.2	1.1E+02	61	0.9	1.3	11.6
	Roofing Mat	Portland	1.9	9.3E+01	19	1.5	0.4	23.8
3500	Enterprise Mat with WUCS/Chopped Roving with EVA Binder	National Starch or Air Products	1.8	8.8E+01	19	1.5	0.3	14.1
5901B	5901 Phenolic and 1" 9501 E Glass WUCS	Borden	2.4	1.2E+02	23	1.8	0.6	26.4
5901A	5901 Phenolic and 0.75" Advantex 9301 WUCS	Borden	2.4	1.2E+02	21	1.9	0.5	24.7
618AL	GL618 and 0.75" Advantex 9501 WUCS	Rohm & Haas	2.1	1.0E+02	16	1.8	0.3	23.7
618EL	GL618 and 1" 9501 E Glass WUCS	Rohm & Haas	2.2	1.1E+02	17	1.9	0.4	24.6
618EL	GL618 and 50% 1" E 9501/50% Chopped 893	Rohm & Haas	2.3	1.1E+02	17	1.9	0.4	19.3
618E	GL618 and 1" E WUCS/Chopped 893/Uni 377 Roving	Rohm & Haas	2.4	1.1E+02	17	2.0	0.4	21.1
618L	Low GL618 on 9501 1" WUCS	Rohm & Haas	2.8	1.3E+02	32	1.9	0.9	26.1
618H	High GL618 on 9501 1" WUCS	Rohm & Haas	3.7	1.8E+02	50	1.8	1.8	28.3
2780L	2780 Acrylic Low Binder Content on 1" 9501 Wet Chop	Rohm & Haas	2.4	1.1E+02	21	1.9	0.5	20.4

Binder Material	Description	Binder Manufacturer	Basis Weight (lb/sq)	Basis (gsm)	LOI (%)	Glass Basis Weight (lb/sq)	Binder Basis Weight (lb/sq)	Thickness (0.001")
2780H	2780 Acrylic High Binder on 50% 1" 9501 and 50% Chopped 893	Rohm & Haas	3.4	1.6E+02	41	2.0	1.4	21.2
2780L	2780 Acrylic Low Binder on 50% 1" 9501 and 50% Chopped 893	Rohm & Haas	2.6	1.3E+02	23	2.0	0.6	18.1
720L	720 Acrylic Low Binder on 1" 9501 WUCS	Rohm & Haas	2.6	1.3E+02	30	1.8	0.8	30.4
720L	720 Acrylic Low Binder on 50% 1" 9501/50% Chopped 893	Rohm & Haas	2.7	1.3E+02	29	1.9	0.8	26.5
720H	720 Acrylic High Binder on 50% 1" 9501/50% Chopped 893	Rohm & Haas	3.4	1.6E+02	41	2.0	1.4	29.1
DX24VL	Dow DX31524 V-Low Binder on 9501 1" WUCS	Dow	2.2	1.0E+02	16	1.8	0.3	22.3
DX24VL	Dow DX31524 V-Low Binder on 50% 1" 9501/50% Chopped 893	Dow	2.3	1.1E+02	14	2.0	0.3	19.9
DX24M	Dow DX31524 on 50% 1" 9501/50% Chopped 893	Dow	2.5	1.2E+02	20	2.0	0.5	20.3
D280VL	Dow 280 V-Low Binder on 9501 1" WUCS	Dow	2.1	1.0E+02	13	1.8	0.3	22.9
D280VL	Dow 280 V-Low Binder on 50% 1" 9501/50% Chopped 893	Dow	2.3	1.1E+02	12	2.0	0.3	19.8
D280M	Dow 280 on 50% 1" 9501/50% Chopped 893	Dow	2.4	1.2E+02	18	2.0	0.4	23.2

Binder Material	Description	Binder Manufacturer	Basis Weight (lb/sq)	Basis Weight (gsm)	LOI (%)	Glass Basis Weight (lb/sq)	Binder Basis Weight (lb/sq)	Thickness (0.001")
DX49VL	Dow DX31549 V-Low Binder on 9501 1" WUCS	Dow	2.2	1.1E+02	17	1.8	0.4	25.0
DX49VL	Dow DX31549 V-Low Binder on 50% 1" 9501/50% Chopped 893	Dow	2.3	1.1E+02	15	2.0	0.3	22.8
DX49M	Dow DX31549 Binder on 50% 1" 9501/Chopped 893	Dow	2.6	1.3E+02	23	2.0	0.6	26.4

TABLE 9B

Binder Material	Description	Binder Manufacturer	Frazier Air Permeability (15/min/ft ²)	Tensile Strength (psi)	CaO Retention (%)	Hot H ₂ O Retention (%)	MD/CD Comments
PVC	PVC Srim - 0/90 PVC/F-Glass Tows (60% LOI)		1600	56	75		0/90 Roving Orientation
3500	Roofing Mat with Enterprise Mat with Wucs/Chopped Roving with EVA Binder	Pottland National Sturck or Air Products	830 990	38 8	61 87-116	96	Oriented Wet Mat Oriented Hybrid Mat
5901E	5901 Phenolic and 1" 9501 E Glass WUCS	Borden	840	21	94	59	Random Wet Mat
5901A	5901 Phenolic and 0.75" Advantex 9501 WUCS	Borden	700	18	53	48	Random Wet Mat
618AL	GL618 and 0.75" Advantex 9501 WUCS	Rohm & Haas	670	18	111	73	Random Wet Mat
618EL	GL618 and 1" 9501 E Glass WUCS	Rohm & Haas	760	25	104	97	Random Wet Mat
618EL	GL618 and 50% 1" E 9501/50% Chopped 893	Rohm & Haas	1000	23	104		Random Hybrid Mat
618E	GL618 and 1" E WUCS/ Chopped 893/ Uni 377 Roving	Rohm & Haas	970	41	98		MD Uni + Random Hybrid
618L	Low GL618 on 9501 1" WUCS	Rohm & Haas	730	41	91		Random Wet Mat
618H	High GL618 on 9501 1" WUCS	Rohm & Haas	630	49	101		Random Wet Mat
2780L	2780 Acrylic Low Binder Content on 1" 9501 Wet Chop	Rohm & Haas	810	10	125		Random Wet Mat
2780H	2780 Acrylic High Binder on 50% 1" 9501 and 50% Chopped 893	Rohm & Haas	830	17	89		Random Hybrid Mat

Binder Material	Description	Binder Manufacturer	Frazier Air Permeability (ft ³ /min/ft ²)	Tensile Strength (psi)	CaO Retention (%)	Hot H ₂ O Retention (%)	MD/CD Comments
2780L	2780 Acrylic Low Binder on 50% 1" 9501 and 50% Chopped 893	Rohm & Haas	930	10	101		Random Hybrid Mat
720L	720 Acrylic Low Binder on 1" 9501 WUCS	Rohm & Haas	780	12	86		Random Wet Mat
720L	720 Acrylic Low Binder on 50% 1" 9501/50% Chopped 893	Rohm & Haas	840	13	63		Random Hybrid Mat
720H	720 Acrylic High Binder on 50% 1" 9501/50% Chopped 893	Rohm & Haas	790	19	99		Random Hybrid Mat
DX24VL	Dow DX31524 V-Low Binder on 9501 1" WUCS	Dow	750	23	94		Random Wet Mat
DX24VL	Dow DX31524 V-Low Binder on 50% 1" 9501/50% Chopped 893	Dow	910	18	88		Random Hybrid Mat
DX24M	Dow DX31524 on 50% 1" 9501/50% Chopped 893	Dow	840	24	91		Random Hybrid Mat
D280VL	Dow 280 V-Low Binder on 9501 1" WUCS	Dow	850	18	93		Random-Wet Mat
D280VL	Dow 280 V-Low Binder on 50% 1" 9501/50% Chopped 893	Dow	1000	12	88		Random Hybrid Mat
D280M	Dow 280 on 50% 1" 9501/50% Chopped 893	Dow	1000	16	88		Random Hybrid Mat

Binder Material	Description	Binder Manufacturer	Frazier Air Permeability (ft ³ /min/ft ²)	Tensile Strength (psi)	CaO Retention (%)	Hex H ₂ O Retention (%)	MD/CD Comments
DX49VL	Dow DX31549 V-Low Binder on 9501 1" WUCS	Dow	810	17	56		Random Wet Mat
DX49VL	Dow DX31549 V-Low Binder on 50% 1" 9501/50% Chopped 893	Dow	960	10	73		Random Hybrid Mat
DX49M	Dow DX31549 Binder on 50% 1" 9501/Chopped 893	Dow	940	20	85		Random Hybrid Mat

[0028] Tables 9A and 9B illustrate that the combination of strands 18, 20, generally maintain or improve the Frazier

Air Permeability of the various systems without significantly adversely affecting mechanical properties such as CaO percent retention and hot water retention. Tables also indicate that tensile strength may be affected as the ratio of wet use chop strands 18 to dry use strands 20 decreases. This is believed to be a result of the dry use strands 20 forming additional logs in the network 14, which increase Frazier Air Permeability but decrease tensile strength of the network 14.

[0029] The mat 10 formed in Fig. 3 above may then be applied to form a cement backerboard 110 in a conventional method such as the method described in U.S. Patent No. 3,284,980 to Dinkel, which is herein incorporated by reference and described below in Figs. 4-9.

[0030] Referring now to Fig. 4-6, into a form 120 of a size of the desired cement backerboard 110 panel, a layer of wet formed permeable mat 10 is laid. A slurry 122 containing hydraulic cement of a suitable consistency to permit penetration thereof through the openings in the open permeable mat 10 is applied, as from the traveling supply pipe 121. The amount of cement slurry 122 introduced is sufficient to cover the mat 10 completely so that substantially all the network 14 is immersed or embedded; the slurry penetrates the openings in the fibers 18, 20 and optional rovings 22 and fills them so that the mat 10 is enveloped on both sides. Normally this is only a light envelopment, although an excess is sometimes needed where the aggregate in the core is large and the boundary surface presented by the core is very rough.

[0031] In the next step, as shown in Fig. 7, the core mixture 124 of aggregate and hydraulic cement is poured into the form 120; the water content is normally kept on the low side within the range for best strength development in the concrete. A typical mix of the core mixture 124 is three volumes of light weight aggregate, one volume Portland cement and three-fourths volume of water. The core mixture 124 is then rodged off flush with the top of the form 120, as shown in Fig. 7, at the top boundary of the core mixture 124 some depressions will usually be present due to the openings between aggregate particles, to voids from the air entrainment or other cause, resulting from the coarse nature of the core mixture 124 composition.

[0032] Referring to Fig. 8, a layer of wet formed permeable mat 10 is laid over the top of the core mixture 124. The thickness of the mat 10 ordinarily is so slight that it does not add materially to the thickness of the core 124.

[0033] As shown in Fig. 9, the last layer of hydraulic cement slurry 122' is poured over the mat 10 from traveling supply pipe 121, or applied by other suitable means. The slurry 122' penetrates the openings in the mat 10 and also into the voids, openings or surface irregularities at the upper boundary surface of core 124. Sufficient slurry 122' is deposited to penetrate and fill the openings and voids in the core 124 surface, to fill the openings in the fibers 18, 20 and to lightly cover the mat 10, or at least be flush with its outer surface; it is then rodged or otherwise leveled. The mat 10 is normally kept as close to the ultimate surface of the finished panel as possible inasmuch as the maximum benefit and greatest strength is thereby realized from the fiber strands 18, 20.

[0034] After the composite panel 110 is prepared it is left in the form 120 for sufficient time to effect initial cure, or complete cure if desired; the use of a plastic film covering to retain moisture or the use of steam curing is advantageous.

[0035] The cement backerboards 110 formed according to the present invention offer many advantages over known PVC glass scrims. These backerboards 110 offer economical advantages in that the mat 10 be formed in a single operation and requires less binder 16 material than known scrim systems. Further, the backerboards 110 formed offer superior decorative finishes by preventing sink marks and pitting.

[0036] In addition, the present invention offers improved cement impregnation because the permeable mat 10 formed is not a completely random network of wet and dry chop strands 18, 20, and optional rovings 22, thereby giving a mat 10 with a higher degree of openness as measured by Frazier air permeability as compared with some known systems. Further, permeability to cement impregnation may be adjusted by simply altering the ratio of wet chop strands 18 to dry chop strands 20 in the mat 10, which in turn affects the ultimate physical properties such as tensile strength within the cement backerboards 110.

Claims

1. A wet formed permeable mat (10) for use in a cement backerboard (110), the permeable mat comprising:

a randomly oriented, open mesh, glass filament network (14) comprising a mixture of a plurality of wet use chop strands (18) and a plurality of dry chop glass fiber strands (20) each having lengths of 1.9 to 3.8 cm (0.75 to 1.5 inches) and the weight ratio of wet use chop strands to dry chop glass fiber strands being 3:1 to 1:3; and an alkaline resistant binder (16).

2. A permeable mat according to claim 1, wherein the randomly oriented, open mesh, glass filament network further comprises a plurality of unidirectional rovings (22) comprising 20 to 50 percent of the total fiber weight.

3. A permeable mat according to claim 1 or claim 2, wherein the alkaline resistant binder comprises 20 to 50 percent by weight of the wet formed permeable mat.
4. A permeable mat according to any one of claims 1 to 3, wherein the alkaline resistant binder is selected from phenolic binders, melamine binders, acrylic binders, styrene-acrylate binders, styrene butadiene binders and ethylene vinyl acetate binders.
5. A method for forming a wet formed permeable mat (10) for use in reinforced cement backboards (110), the method comprising:
 - forming a thick slurry (72) of a whitewater chemical dispersion (71), a plurality of wet use chop strands (18) and a plurality of dry chop glass fiber strands (20);
 - introducing the thick slurry into a thin stock stream slurry (76) to form a lower consistency slurry (80);
 - introducing the lower consistency slurry to a former (82),
 - aligning the plurality of wet use chop strands and the plurality of dry chop glass fiber strands within the former to form a web (14);
 - partially drying the web;
 - Introducing an alkaline resistant binder (16) to the web; and
 - drying and curing the alkaline resistant binder and the web to form the wet formed permeable mat.
6. A method according to claim 5, wherein the thick slurry comprises a cationic dispersant, an anionic viscosity modifier, a defoamer, a blockie, the plurality of wet use chop strands and the plurality of dry chop glass fiber strands.
7. A method according to claim 6, wherein the thick slurry is formed by
 - a) Introducing a cationic dispersant into a tank (70) under agitation;
 - b) introducing a mixture of a plurality of wet use chop strands and a plurality of dry chop glass fiber strands into the tank, the weight ratio of wet use chop strands to dry chop glass fiber strands being 3:1 to 1:3;
 - c) adding a defoamer to the tank; and
 - d) adding an anionic viscosity modifier to the tank.
8. A method according to claim 7, wherein the thick slurry comprises also a plurality of unidirectional rovings (22).
9. A method according to claim 8, wherein the method according to claim 7 includes the additional step, following step (a), of introducing a plurality of unidirectional rovings into the tank in an amount to comprise 20 to 50 percent of the total fiber weight.
10. A method according to any one of claims 6 to 9, wherein the anionic viscosity modifier is selected from polyacrylamide viscosity modifiers, hydroxyethyl cellulose viscosity modifiers and polyamine viscosity modifiers.
11. A method according to any one of claims 6 to 10, wherein the cationic dispersant is selected from ethoxylated alkylamine dispersants, amine oxide dispersants and polyethoxyylated derivatives of amide condensated fatty acid dispersants.
12. A method for making a cement backboard (110), the method comprising:
 - introducing to a form (120) a first layer of a wet formed permeable mat (10) according to any one of claims 1 to 4;
 - introducing a cement slurry (122) onto the first layer in a first amount sufficient to cover the first layer;
 - Introducing a layer of a core material (124) onto the first amount of the cement slurry sufficient to cover the cement slurry;
 - Introducing a second layer of the wet formed permeable mat onto the layer of the core material;
 - introducing the cement slurry (122) onto the second layer in a second amount sufficient to cover the first amount; and
 - curing the first amount and the second amount of cement slurry.
13. A method according to claim 12, wherein the wet-formed permeable mat is formed by a method according to any one of claims 5 to 11.

EP 1 346 964 A2

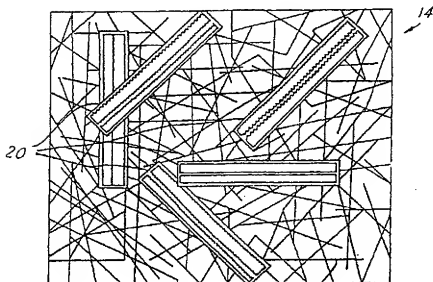


FIG. 1

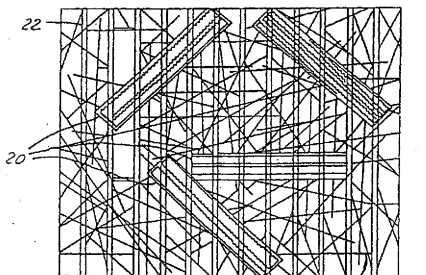


FIG. 2

EP 1 346 964 A2

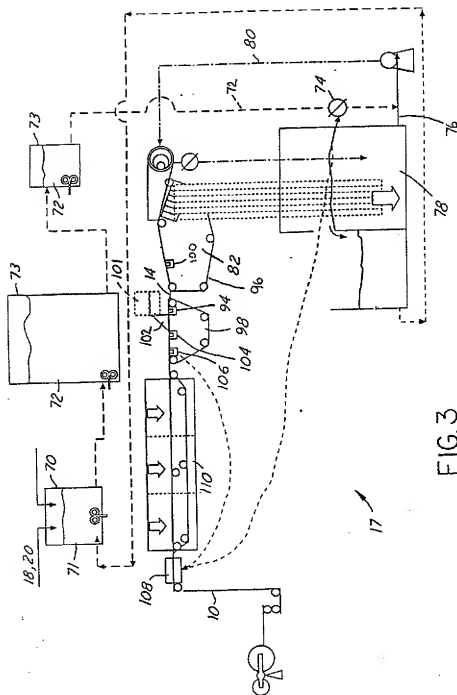


FIG. 3

EP 1 346 964 A2

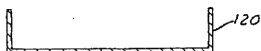


FIG. 4



FIG. 5

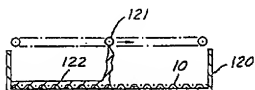


FIG. 6

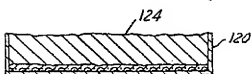


FIG. 7

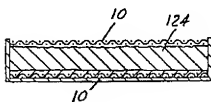


FIG. 8

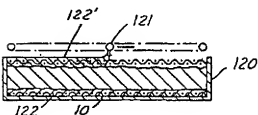


FIG. 9